Impacts of Road Crossings on Fish and Wildlife

John Magee
NH Fish and Game Department

John.magee@wildlife.state.nh.us
(603) 271-2744

Objective

- To provide an overview of biological issues related to stream crossings.

Stream Crossings

- Get you from A to B
- Can impact aquatic species and their habitat
- Good stream crossing design is interdisciplinary

Stream Crossings Can Affect (among other things):

- Aquatic Organism Passage (AOP)
- Fish and Wildlife Corridors
- Geomorphology (= habitat, erosion/sedimentation, nutrients)

Streams as Fish Habitat

Habitat
- Water quality
- Water depth
- Velocity
- Substrate
- Wood
- Riparian vegetation
- Other vegetation

Why Fish Move

- To find better habitats

- To avoid threats

Why Fish Move

- Fish need to access the habitat that increases their chances of survival
  - Foraging (have to get to the grocery store)
  - Spawning (live in a good neighborhood)
  - Rearing (take the kids to school)
  - Access new or vacant habitat (new subdivision going in)
- Fish avoid certain areas to increase their chances of survival
  - Water quality (thermal or chemical pollution)
  - Lower (or higher) water levels
  - Changing habitat conditions (e.g., due to ice scour/flood)

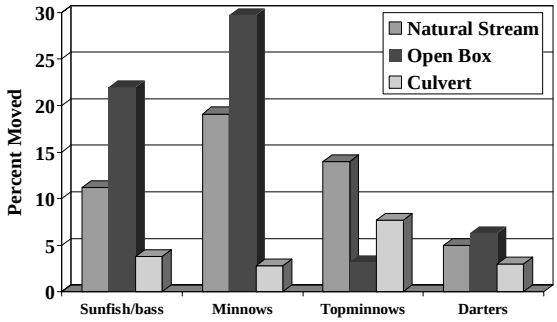
Fish Must Move

- Population health requires short and long-term movement of individuals.

Fish Move for Various Reasons

- Species specific
  - Some species move:
    - frequently
    - infrequently
    - seasonally
    - very short distances
    - very long distances
    - into intermittent streams

Impact on Fish Passage



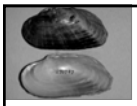
Warren and Pardew. 1998. Road Crossings as Barriers to Small-Stream Fish Movement. Trans. Amer. Fisheries Soc. 127:637-644

Impact on Fish Passage

	Natural Stream		Culvert	
Group	**Summer**	**Fall**	**Summer**	**Fall**
Trout	13.73	12.28	0.00	5.49
Average (%)	13.00		2.75	
Minnows	5.09	3.89	2.84	1.79
Average (%)	4.49		2.32	
Perch/Sculpin	2.93	0.66	0.79	0.44
Average (%)	1.79		0.62	

- **Behavior plays a role, but may be impossible to quantify**

Coffman. J.S. 2005. Evaluation of a Predictive Model for Upstream Fish Passage Through Culverts. M.S. Thesis. James Madison University

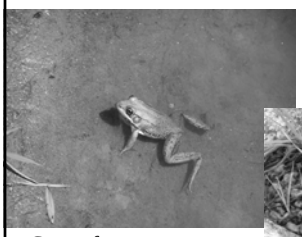


Mussels

Biology - requires host fish for larval stage (glochidia)

Species	Fish host	Status
Brook floater	Longnose dace, golden shiner, slimy sculpin	State endangered
Eastern pondmussel	unknown	Special concern- NH; regional concern- Northeast
Dwarf wedgemussel	Tessellated darter, slimy sculpin, Atlantic salmon	Federal & state endangered

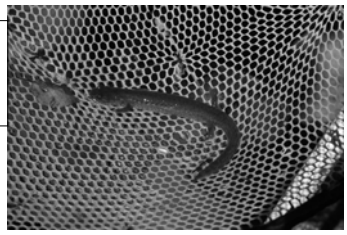
Amphibians



Green frog

N. Leopard frog

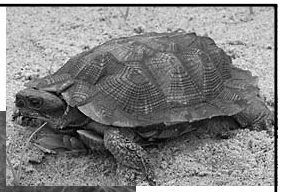
NH Stream Salamanders



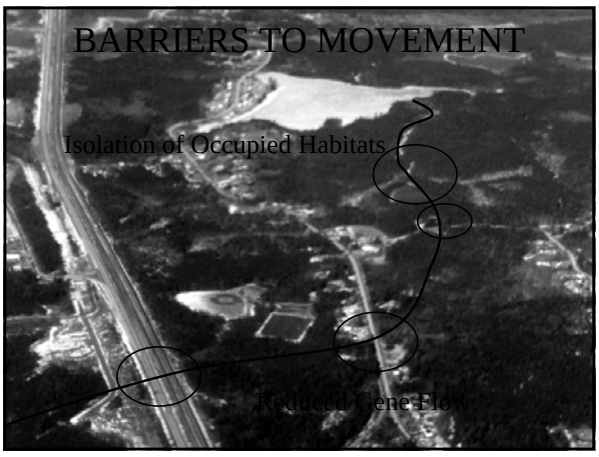
- Two-lined salamander
- Spring salamander
- Northern dusky salamander

Reptiles

Wood Turtles



BARRIERS TO MOVEMENT



The Viability Cornerstone

The key to viability in fish populations, as we have found with most wildlife populations, is maintaining a system of INTERCONNECTED, diverse, high-quality habitats.

Brian Riggers and Shane Hendrickson, USFS, Lolo National Forest, 2005

Fluvial Geomorphology

"The study of landform evolution related to stream systems"

(how flowing water moves sediment and wood)

Leopold, L.B., and T. Maddock Jr., 1953.

The Hydraulic Geometry of Stream Channels and Some Physiographic Implications. U.S. Geological Survey Professional Paper 252, 57 pp.

Fluvial Geomorphology

- Flowing water moves sediment and wood
- Bankfull flow – everything relates to it and the drainage area
  - Channel-forming flow
  - Occurs about every 1.5 years
- Channel Classification – allows for the prediction of how the stream will respond to changes
- Natural Channel Design = Stream Simulation

Specific Problems - Geomorph

- Bank erosion
- Sedimentation
- Nutrient/pollutant loading
- Stream warming
- Decrease/elimination of woody debris
- Direct habitat loss

Over time…

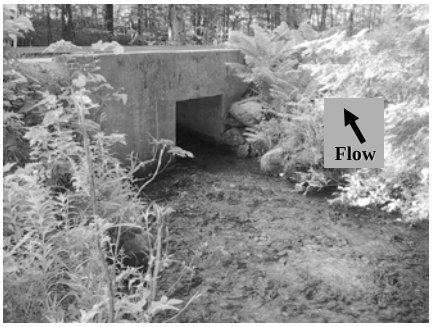
1979 – Siegel Creek

1998 – Siegel Creek

Photos courtesy of Dan Cemerelli, USFS

Undersized Culvert

Undersized Culvert



Drainage From Road

- **Increased Water Temperature**
- **High salt and sand load**

Poor Crossing for Aquatic Organisms

- Hanging (perched)
- Water drops onto boulder
- Very little water depth
- Dark!

Stream Simulation

- Simulate the Natural Channel in terms of:
  - Width
  - Slope
  - Substrate
  - Water velocities
- Allows for channel stability over a broad range of flows
- Maintains aquatic and riparian habitat
- Provides sustained ecological integrity

Recommendations for Stream Crossings

- Maintain natural substrate (open bottom is best option)
- Maintain aquatic species passage
- Wider than bankfull width
- Allow for sediment and wood transport
- Maintain storm flow capacity
- Maximize light penetration

Conclusions

- Stream crossings can and often lead to:
  - Altered geomorphology (habitat, erosion, sedimentation, nutrients)
  - Disruption/elimination of aquatic organism passage
  - Population impacts
- Fish and wildlife populations need a system of diverse, ***interconnected***, high-quality habitats.

"Ultimately, our goal should be to create a transportation infrastructure that does not fragment or undermine the essential ecological infrastructure of the land and its waterways."

S. Jackson 2004. Massachusetts River and Stream Crossing Standards: Technical Guidelines